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ABSTRACT

In measuring affective evaluations of complexity, two questions have been generated by findings in the literature: (1) whether the response indicators, "interesting," "pleasing," and "liking," represent interchangeable labels for the same evaluative responses, and (2) whether these evaluations evidence a positive attitude towards complex stimulation by young children and a less positive attitude with older children and adults. In attempting to answer these questions, subjects from grade one through grade 13 were shown 15 pairs of random polygons, the alternatives differing in level of complexity, and asked to select the alternative they "liked," "found more pleasing," or "found more interesting." Analysis of the number of "more complex" (defined in terms of number of sides) selections made by each grade and response group suggested that complex stimuli were considered to be more interesting than either pleasing or likeable. There was also a significant decrease in liking for more complex stimulation with age. Results were interpreted as supporting research which has argued that the verbal evaluations of "like," "interesting," and "pleasing" are not synonymous although related, and findings that positive evaluation of complexity decreases with age. (Author/DR)

AN EXAMINATION OF CHANGES IN ATTITUDES TO VISUAL COMPLEXITY WITH INCREASING AGE

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Change in attitude towards complexity with growth and maturation is of interest both psychologically and educationally. Psychologically, the positions adopted by Dember and Earl (1957), Berlyne (1960, 1963), Walker (1964) and Munsinger and Kessen (1964) seem to predict similar consequences of experience with complexity, that is, following exposure to complex stimulation an organism should choose or show preference for exposure to a higher level of complexity. This has been demonstrated with animals (Dember, Earl, & Paradise, 1957; Walker, 1964) and with adult humans (Berlyne, 1960; Munsinger & Kessen, 1964).

Since it is generally considered that the events which occur between the ages "n" and "n + $\triangle$n" include exposure to complex stimuli, it seems reasonable that an increase in preference for complexity should occur with increase in age. But empirical evidence to date does not substantiate such a prediction; indeed, the reverse seems to be the case. Results by Munsinger, Kessen, and Kessen (1964) and Thomas (1966) point to a decreasing preference for complexity with increasing age.

Educationally, these findings have particular relevance, since critics frequently charge the educational system with responsibility for destroying curiosity and creativity in students. Indeed,

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Munsinger, Kessen and Kessen (1964) suggest that one possible explanation for their results might be that

> ... the positive response of young children to figures of high variability is systematically reduced by the inhibiting influence of training in school and the wider culture. (p. 10)

Furthermore, since Barron (1963a, 1963b) has demonstrated a positive relationship between preference for complexity and creativity, there should be concern that education may also contribute to a possible decrease in creativity with increasing exposure to the school system.

Since arguments of this sort are rather serious indictments of both the educational system and society as a whole and the available evidence is inconsistent with theoretically derived expectations, it seemed reasonable to investigate more thoroughly the question of developmental changes in attitudinal responses to complexity.

Following the approach of both Munsinger, Kessen and Kessen (1964) and Thomas (1966), randomly generated black on white polygons were used in the present study. It has generally been recognized in psychological research that any stimuli chosen from the "natural" environment may be differentially familiar and meaningful to any group of subjects (Ss). Therefore, when factors other than those relating to the stimuli themselves are being investigated it is accepted practice to use stimuli which have a greater possibility of being uniformly unfamiliar to all Ss. This practice is exemplified in the use of "nonsense syllables" in verbal learning experiments and in the use of "random polygons" in the investigation of responses to visual complexity. Pictures of the particular figures used in this experiment are presented in Appendix A. These figures have been constructed using a method first described by Attneave and Arnoult (1956) which involves the random selection of coordinates on a matrix and joining of these coordinates by

straight lines in a well defined manner. The figure produced is then photographed and frequently, as in this research, presented as black on white pictures by means of slide projectors. The reason for dealing with only this dimension when so little information is available about the effect of other dimensions such as symmetry, meaningfulness, and novelty, as well as the interaction of these dimensions in more common stimuli is because Attneave and Arnoult have shown that complexity accounts for the major portion of the variability in these figures.

The research was designed to test three major hypotheses derived from previous research and theory. The first hypothesis reflecting the findings of Munsinger, Kessen and Kessen (1964) and Thomas (1966) predicted that preference for the more complex figures will decrease with increasing grade level.

The second hypothesis tested derives from a suggestion made by Munsinger, Kessen and Kessen (1964) to explain their results. They argued that the reason young Ss indicated greater preference for the complex stimuli than older Ss was in effect, because young children are not able to respond adequately to stimuli of high variability and therefore, they treat all high complex stimuli as if they were the same. If this were the case, then it seems reasonable to expect that when asked to select the "more simple" alternative of a pair of stimuli, young children would respond as if all the complex stimuli are identical.

The third hypothesis was based on research comparing the characteristics of and relationships among different attitudinal response measures. Berlyne (1963) showed that the response measures "pleasing" and "interesting" to the same stimulus objects were different and unrelated. He suggested that the former reflected a reaction to arousal-inducing properties of the stimulation, while the latter, pleasingness,

reflected a reaction to arousal-mitigating or arousal-reducing properties of the stimulation.

Day (1965, 1967) further elucidated this relationship and showed that interest describes an inverted U-shaped distribution over complexity reaching a peak at the 28-sided level of complexity while pleasingness appears to be less dependent upon variations in complexity but generally tends to decrease with increasing variability. In addition, Day (1968) discussed the terms "liking" and "preference" and suggested that they include elements of both pleasingness and interest but are probably more similar to the former.

Thus, there seem to be two independent response terms "pleasing" and "interesting" which reflect rather different attitudes towards complexity among adult Ss. Judged preference or "like" is the only response term used to date with children in this type of study and so it was decided to replicate partially the work of Munsinger and of Thomas. In addition, in order to gain information about changes in response to visual complexity over age and make more feasible comparisons with data obtained from adults, the other two response measures were incorporated into the experimental design. Hypothesis three, therefore, predicted that different response curves would be obtained for "pleasing" and "interesting" responses. The third response function, "like", was expected to be somewhere between the other two and resemble "pleasing" more than "interesting".

Method

Four classes of students from each of the grades I through 13 were randomly assigned to one of four instructional groups, such that one class from each grade responded under each of the four conditions. The Ss were instructed to select the more interesting, more pleasing,

more likeable or simpler of each of 15 stimulus pairs. The stimuli were random polygons, five at each of six levels of complexity (Appendix A), presented as black on white pictures by means of 35 mm slide projectors. The method of paired comparisons was used except that each stimulus was only used once but each complexity level was paired with every other complexity level. Subjects from grades 1 through 8 were tested in their own classrooms and Ss were provided with prepared answer sheets and asked to indicate by making an X in the box marked "L" or "R" which alternatives they selected. A large "L" and "R" was attached to the screen to assist Ss in grades 1 to 3.

Results and Discussion

Data bearing on the first hypothesis which stated that young Ss would show greater preference for complex figures than older Ss were obtained through the use of a "complexity score". This score was calculated for each S in the "interesting", "pleasing", and "like" groups by counting the number of occasions, in the 15 presentations, on which the more complex alternative of the stimulus pair was selected. These scores were then analyzed in an analysis of variance. Since grade one Ss showed considerable difficulty in performing the task, scores from 1/3 of the Ss had to be eliminated because they either marked both left and right choices or neither for one or more stimulus pairs, grade one Ss were excluded from further analysis. Table 1 presents these results.

Insert Table 1 about here

The results presented in Table I indicate that both grade and instruction significantly effect the scores obtained but their interaction was not significant. This suggests that the various attitudes towards complexity changed similarly over grades.

A further analysis to test the slope of the function described by the scores obtained under the three instructional conditions was calculated and is presented in Table 2.

Insert Table 2 about here

The results presented in Table 2 show that under the instructional conditions "like" and "interesting" the scores describe a significantly negative function across grades. It seems to be evident that young Ss selected more complex stimuli than did older Ss under these two instructions. The slope for the "pleasing" function tends to be negative but not significantly so.

These results seem to confirm the hypothesis stating that there is a decrease in preference for complexity with increasing grade level and is generally consistent with the results obtained by Munsinger, Kessen and Kessen (1964) and Thomas (1966).

Results relating to hypothesis two stating that young Ss would show an inability to identify an underlying continuum of complexity, are shown in the graphed function of the normal deviate scores obtained under the "simple" instructional condition. The normal deviate scores are essentially scaled values of the number of times each complexity level is selected over all other complexity levels in the class. In the calculation of these scores a marked rejection of the figures at the 40-sided level was revealed. Further investigation of the particular five

experimental figures used, suggested that there seemed to be some characteristics unique to these stimuli apart from the similarity in number of sides. When presented with other slides to 12 adult Ss who had been asked to sort them into sets on any basis they wished to use, all Ss placed at least four of the test slides in the same set and two Ss placed all five experimental slides into the same set. The 40-sided figures were therefore deemed to be extraordinary samples of the universe of 40-sided figures and were excluded from this analysis. Figure 1 presents the graph of the normal deviate scores for responses of Ss in grades 1, 2, and 3, excluding the 40-sided figures.

Insert Figure 1 about here

Figure 1 shows that grade 1 Ss had considerable difficulty indicating the "more simple" of each alternative while grades 2 and 3 Ss showed no evidence of difficulty at all. It should also be noted that the percentage of Ss excluded because of errors made in these grades was 58%, 33% and 16% for grades 1, 2, and 3 respectively.

It seems that hypothesis two has received considerable support in that many of the Ss in grade 1 who were able to cope with the task, did seem to treat the stimuli as if they were all the same. The grade 2 Ss showed a fairly high percentage of spoilage and the grade 3 Ss considerably less but of the Ss who could handle the task in both the latter groups most seemed to be able to identify the "more simple" alternative. Therefore, the hypothesis received support especially in regard to grade 1 Ss.

In stating this hypothesis, Munsinger, Kessen and Kessen (1964) were attempting to explain the greater preference found for Ss from

6 through 15 years of age. Since this greater preference was still obtained when grade I data were excluded, the suggestion that young children are unable to process adequately stimuli of high variability seems to be an inadequate explanation of the phenomenon.

The third hypothesis was based on findings with adult Ss that argued that "interestingness" and "pleasingness" describe different shaped functions over complexity, the former resembling an inverted U reaching a peak at the 28-sided level. Since it was also hypothesized that lower grade Ss preferred higher levels of complexity it was felt that the peak for younger Ss might even be at a higher level of variability than the 28-sided figure. "Pleasingness" ratings were hypothesized to be different than "interestingness" and generally less related to variability. The results generally tended to bear out this hypothesis, as shown in Figure 4, "interestingness" peaked at 28 sides for the older Ss but at 48 sides for the younger Ss.

Insert Figure 2 about here

"Pleasingness" choices were significantly different from "interestingness" choices. While "pleasingness" also peaked at the 28-sided level, it decreased with increasing variability and examination of the distribution suggests that factors other than variability are effective in shaping the distribution. Linear contrasts summarized in Table 3, gave statistical evidence that the two were significantly different.

Insert Table 3 about here

Responses in the "liking" instruction group differed significantly from "interestingness" but not from "pleasingness" responses but as seen in Figure 2, lies somewhere between the two. It may be that since this is a composite score of all Ss, more of them regard this response as equivalent to "pleasingness" and a minority to "interestingness".

Thus the third hypothesis also received support and the findings of this research with Ss from grades I through 13 not only give support to Day's results with adult Ss, but extend understanding of the relationship downward in age.

Conclusions

The research reported tended to support the three major hypotheses. Evidence was obtained, which confirmed previous research, that preference for complexity decreases with grade level. In addition, evidence was obtained to suggest that young Ss (grade I's) even when able to respond correctly often fail to recognize the "more simple" alternative reliably. While data from many ss from both grades 2 and 3 were excluded because of errors, Ss in these grades are much more able to recognize the more simple alternative (as, of course, are Ss from grade 4 through 13). Furthermore, evidence was obtained to suggest that children, like adults, respond differently when asked to select the "more pleasing" or the "more interesting" alternative, the former peaking at a moderate level of complexity, the latter peaking at a higher level of complexity. Selections based on "liking" seem to be some combination of the first two, more similar to "pleasing" than to "interesting".

With the additional evidence found here that preference for and interest in complexity decreases with increasing grade level, one

can only agree with the conclusion of Munsinger, Kessen and Kessen on the educational and cultural effects on our children. Preference for and interest in complexity has been used as a measure of curiosity (Berlyne, 1960; Day 1965, 1967) and creativity (Barron, 1963a, 1963b). Frenkel-Brunswik (1951) argued that a positive attitude towards complexity in the perceptual field was associated with a tolerance for complexity in the conceptual and personality areas. It appears that as children are exposed to the educational and social milieu, these characteristics, often professed to be important goals of education, become weaker.

One reason may be that formal education sees as a function the rejection of variability in the environment, labelling this as unwanted "noise". Statistically, random variations are rejected and scientific methodology systematizes effects and counterbalances any threat of random variability. As a result an antipathy towards disorder and randomness and a stress on uniformity is inculcated in our youth. Popular music has become repetitive, stereotypical and tending to simple rhythms and melodies. Popular art is neat and uncluttered, often with straight or simply curved lines and pure "clean" colours. Diversity in dress and appearance is rejected in the traditional school setting.

Yet one still remains reluctant to condemn the educational system. Scientific methodology tries to teach us to seek the weaknesses in empirical evidence and to continue to investigate all alternatives.

Are we fair in extrapolating a general rejection of complex stimulation from data based on low meaningful random polygons uncommon in everyday life? Experimental psychologists have argued for the commonality of principles across all types of material and for the applicability of laws derived from special material which exemplifies the complete class of stimuli. At the same time one must accept the

principle that adding dimensions may do more than add variability, there are interactive effects which may increase effects multiplicatively or exponentially.

Only by a process of continual testing or principles on different materials can substantive laws be formulated. The use of random polygons in this research and other works by Day and his associates, has provided some critical base-lines from which further research can proceed. Among the many projects currently under way and planned, is one which will directly emerge from this one and will involve the use of pairs of incongruous figures rather than random polygons. Thus, while starting with random and essentially meaningless figures the hope is to proceed, gradually, to the use of more "natural" stimuli. Therefore, at this point, one should proceed cautiously in evaluating the impact of the educational system on curiosity and creativity while noting the results of this and similar studies.

TABLE I

A Two-Way Analysis of Variance with Unequal N's of Complexity Scores for Ss from Grades 2 through 13 under Three Instructional Conditions

(N = 1057)

Source	M.S.	df	F	P
Total	5.119	1056		
Between	13.281	35		
Grade	15.922	11	3.2899	0.0003
Instruction	84.917	2	17.5463	0.0000
Interaction	5.449	22	1.1258	0.3106*
Within	4.840	1021		

* Not significant

TABLE 2

Tests of the Slope of the Regression Lines Calculated for Complexity Scores on Grades for Ss from Grades 2 through 13 under Three Instructional Conditions (N = 1057)

Instruction	r	t	df	p[x]
Like	-0.5883	-2.3006	11	0.025
Interesting	-0.5198	-1.9241	11	0.05
Pleasing	-0.2897	-0.9570	11	-*

[x] One-tailed test

* Not significant

TABLE 3

Linear Contrasts for Differences between Means of Complexity Scores Obtained by Ss in Grades 2 through 13 under Three Instructional Conditions (N = 1057)

Instructions	Means	Comparisons	t	P
Like	9.0642	Like-Interesting	-2.4644	0.01
Interesting	9.6399			
Pleasing	8.6463	Like-Pleasing	-1.8036	-*

* Not significant

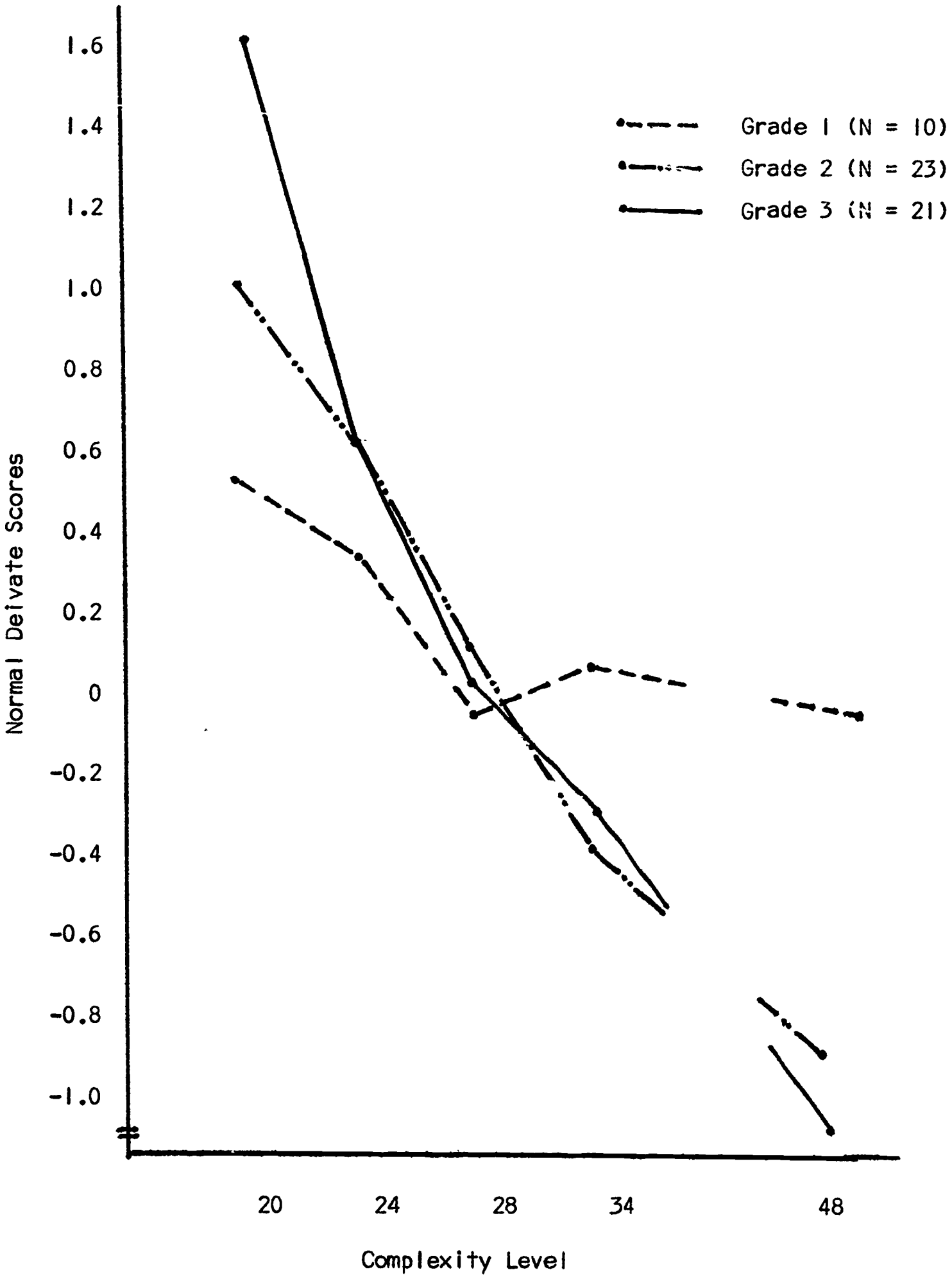


Figure 1. Normal deviate scores obtained by Ss in three grades in response to the instructions "more simple" with stimuli at five levels of complexity.

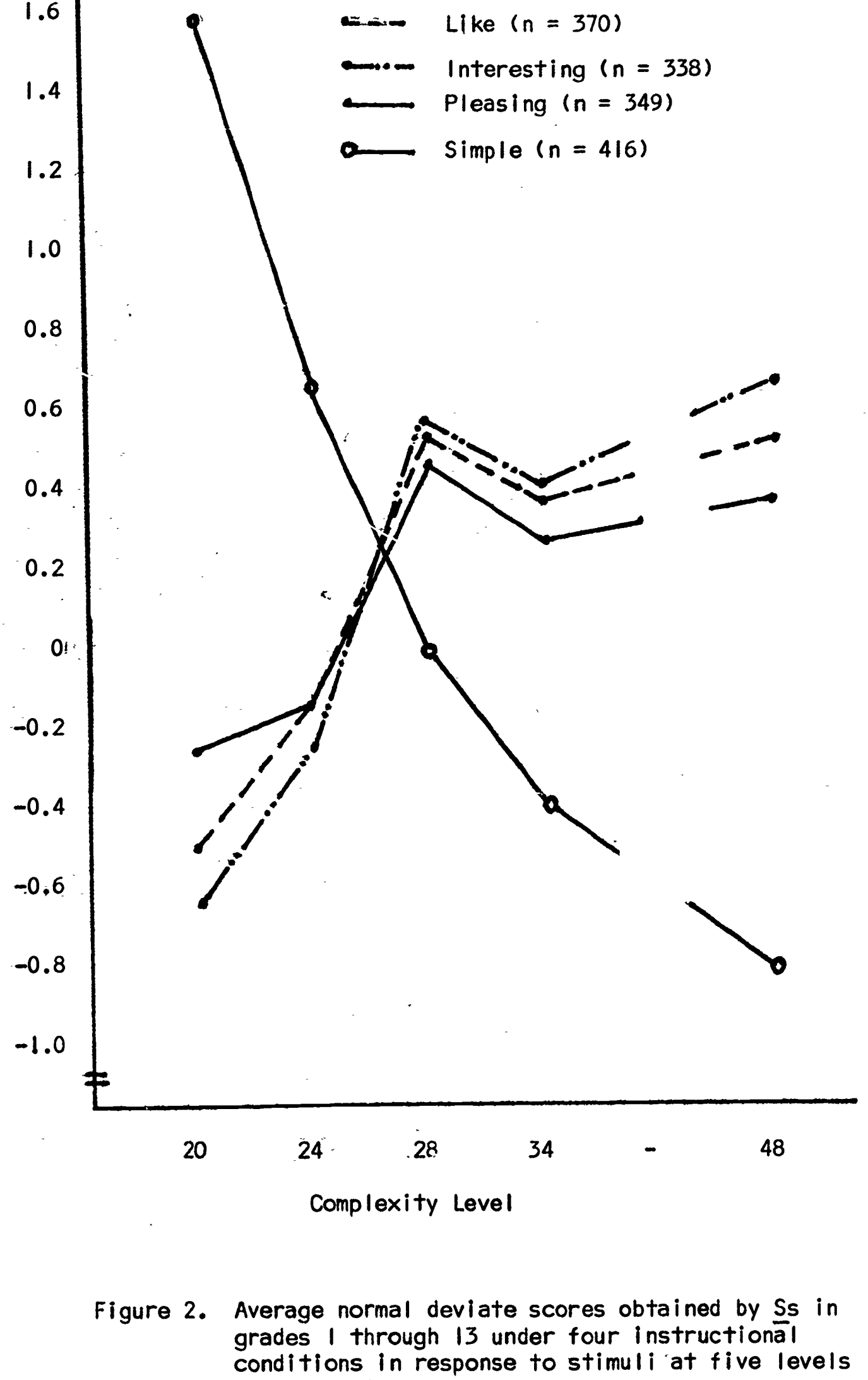
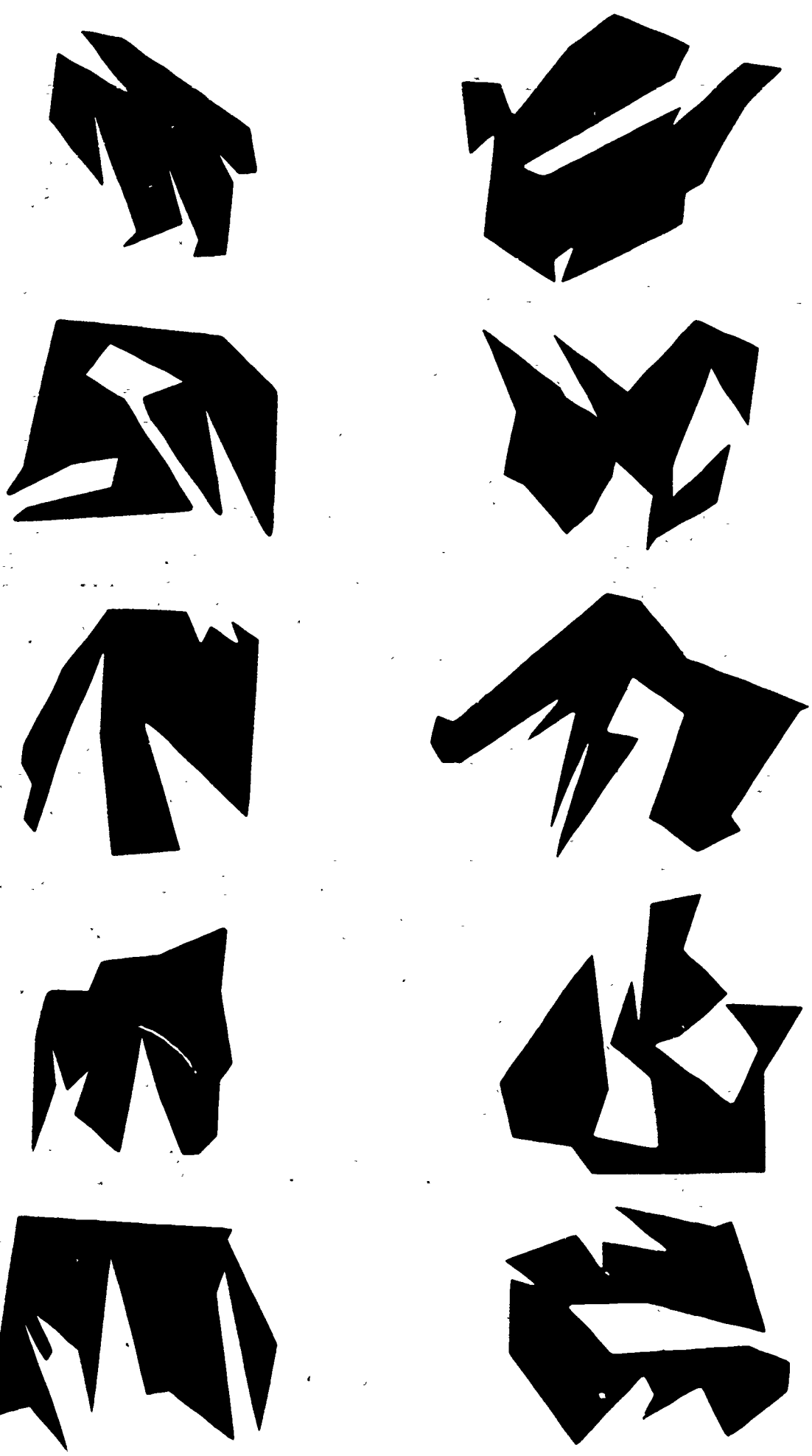


Figure 2. Average normal deviate scores obtained by Ss in grades 1 through 13 under four instructional conditions in response to stimuli at five levels of complexity.

APPENDIX A

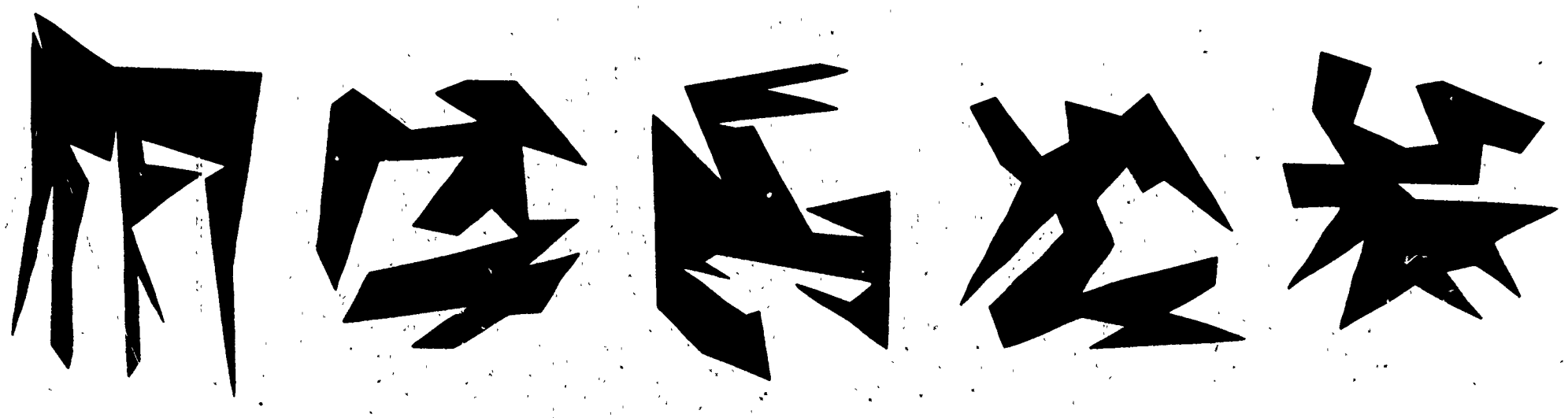
RANDOM POLYGONS



20 sided

24 sided

34 sided



28 sided

48 sided

40 sided